COUPLING MECHANISMS BETWEEN THE THUNDERSTORMS/LIGHTNING AND THE UPPER ATMOSPHERE/IONOSPHERE SYSTEM – IAGA DIVISION 2. AERONOMIC PHENOMENA

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Connection related to the 11-year solar cycle was found in the areal variation of global lightning activity based on background Schumann resonance (SR) observations in the Széchenyi István Geophysical Observatory at Nagycenk (Sátori et al. 2013). Thunderstorms occupy larger area at solar minima and are more confined just at solar maxima.

A northward shift of the position of the centroid of global lightning activity in the years from the solar minimum of 1996 to the deeper solar minimum of 2008/2009 resulted from a more marked warming in the northern hemisphere than in the South. The frequency of the fundamental SR mode (f1) of the vertical electric field in summer was found to be higher in 2008 than in 1996, whereas f1 for the north-south magnetic field component was lower. That signature was responsible for the conclusion of a northward shift (Sátori et al. 2013)

Five gigantic jets (GJs) have been recorded with video and photograph cameras on 7 March 2010 above an isolated tropical storm east of Réunion Island (Soula et al. 2011). Extremely low frequency (ELF, 3-3000 Hz) radiation produced by the GJs had been recorded at Nagycenk and was used to find out that these enormous troposphere-ionosphere discharges raised negative charge towards the lower ionosphere and possessed charge moment changes (CMCs) of 2000-8000 Ckm.

ISUAL unit of the FORMOSAT-2 satellite captured numerous „sprite-halo" events in 2004-2007. SR-transients belonging to these events were identified at Nagycenk. It was concluded that the larger part of the „sprite-halo" events relates to impulsive lightning strokes with negative polarity. These were mainly observed above the oceans and seas while the sprite-halo"-s with positive parent strokes rather occurred above the lands (Williams et al. 2012).

Sprites observed from Sopron above Central Europe were classified on the base of their optically perceptible characteristics (Bór, 2013). Time sequences of streamer propagation directions can be associated with characteristic sprite types. It was found that the average optical lifetime of events in which sprites of different shapes occur is longer than the average optical lifetime of events of a single sprite shape. Additionally, sprite events with many sprite elements don't seem to have very long duration.

The impact of two consecutive intensive positive lightning discharges on the atmosphere has been investigated using simultaneous optical observations and multi-site electromagnetic (EM) wave recordings in the overall frequency range ~4 Hz to 66 MHz (Füllekrug et al. 2014). ELF band EM records from Nagycenk were utilized to deduce the CMCs of the discharges and contributed to inferring that electron acceleration processes above the thundercloud due to the lightning strokes have caused a sprite and a subsequent relativistic electron beam.

Atmospheric EM signals due to a cosmic gamma flare were observed in distant SR stations, among others at Nagycenk, and were modeled by a parametric current pulse (Nickolaenko et al. 2013).

ELF band EM records from NCK were utilized also in investigating a thunderstorm in the north-western region of Mediterranean Sea which has produced several large sprite events in September, 2009 (Soula et al. 2014). CMCs associated with the sprite events ranged from ~400 to 2100 Ckm. It was found that other sprites occurred before all very large carrot sprite events within a few tens of milliseconds. Preceding sprites can enhance subsequent sprite initiation when a new +CG stroke follows the previous one rapidly.

It was shown by SEA (Superposed Epoch Analysis) that the critical frequency of sporadic E-layer (foEs) significantly decreased after the maximum lightning activity (zero hour) based on ionosonde measurements in Rome and lightning observations in the vicinity of Rome (Barta et al. 2013).

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The sporadic E-layer has in fact disappeared during the time red sprites were observed above the thunderstorm as it was indicated by ionosonde records at Pruhonice near Prague. Either gravity waves generated by the thunderstorm or electrons accelerated by a huge static field above the thunderstorm and attaching to the dust particles of Es-layer can cause electron density decrease of Es-layer.

A new electric field mill, Boltek EMF-100 was installed in 2012 and started measurements to get experience with the equipment. The potential gradient (PG) measurement was upgraded in the Széchenyi István Geophysical Observatory applying new automatisms

A computer code was written for finding SR-transients automatically and implemented it for real data sets and tested the results. The importance of the code is the automatism. It would require more than one day to find SR-transients visually for a single day. The daily distribution of background SR and SR-transients were compared.

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